NASA Science Mission Directorate - Applied Sciences Program

Carbon Management – Fiscal Year 2005 Annual Report [*]

SUMMARY

The Carbon Management program element develops partnerships with federal agencies and other organizations that have responsibilities for monitoring and managing emissions and sequestration of carbon. To date the program has focused on the sequestration of carbon in terrestrial systems and the enhancement of tools, such as Carbon Query and Estimation Tool (CQUEST) and the Terrestrial Observation and Prediction System (TOPS), that use NASA Earth observations and model results to provide more accurate information on the likelihood to store carbon in specific terrestrial environments. The Carbon Management program element works closely with the Carbon Cycle and Ecosystems Focus Area within the NASA Earth Science Division.

In FY05, the program initiated several projects selected under the 2004 NASA Carbon Cycle solicitation, including cost-sharing with the Earth Science Research Program or USDA. The program made significant progress on projects initiated in 2004 and 2005, and the program expects verification and validation of the products from these projects in 2006.

MAJOR ACCOMPLISHMENTS

CQUEST – Carbon Query and Evaluation Support Tools

CQUEST is an internet-based query and modeling application that allows users to model carbon sinks and CO_2 fluxes in agricultural and forest ecosystems for any location within in the United States. CQUEST is based on the use of Earth science products derived from MODIS and is integrated with the NASA-developed CASA model. The tool is currently being evaluated on its ability to predict and monitor carbon sequestration by organizations in USDA and DOE.
http://geo.arc.nasa.gov/website/cquestwebsite/

In FY05, the CQUEST project team completed a U.S. national carbon sequestration inventory using MODIS 1-km land surface products and completed an historical reconstruction of U.S. carbon pool baselines for the past 20 years using AVHRR 8-km land surface products. The team also completed a national analysis of soil carbon changes resulting from land use change. In FY06, the CQUEST team will generate CASA model products for net primary production (NPP) annual carbon flux and above ground carbon pools for priority USDA study sites, and it will integrate CERES satellite products into CASA model results.

Linking Landscape-Scale Carbon Monitoring with Forest Management

The Carbon program initiated this project in FY05, and the project team developed correlations between USDA/Forest Service Forest Inventory and Assessment forest types, MODIS land classes, and CASA land classes. The project also completed biometric measurements for study sites to measure carbon stocks and began evaluating the use of AVHRR and MODIS data in CASA for current and historical carbon inventories. In FY06, the project team will estimate and map carbon stocks and productivity for landscape sites using LiDAR and other resources. The project will also link models to multi-scale data sets and integrate CERES satellite products into CASA model results.

---

[*] The FY05-09 Carbon Management Program Element Plan is available through: *http://aiwg.gsfc.nasa.gov/dss.html*

Global Land Cover Facility
The Global Land Cover Facility (GLCF) develops and distributes remotely sensed satellite data and products that explain land cover from the local to global scales. In FY05, the project team standardized over 2000 Landsat scenes and ingested an additional 630 Landsat scenes, developed MODIS enhancements plan and processing, extended data sharing technologies and plan for the continuation of data grids and the Open-source Project for a Network Data Access Protocol (OPeNDAP), and contributed to the United Nations Environment Program's report *One Planet, Many People*. The GLCF archive is open to researchers; FY05 downloads from this archive totaled 104,493,091 MB, and the project team responded to 1,250 requests for assistance. In FY06, the project team will ingest additional MODIS data and complete visualization enhancements. *http://glcf.umiacs.umd.edu/index.shtml* and *http://opendap.org/*

Development of a Framework and Modeling Tool for Spatially-Explicit Full Carbon and Greenhouse Gas Accounting at the Regional to National Scale
Initiating this project in FY05, the project team completed the delineation of land cover using Landsat, and the team combined this product spatially with respective soils data and crop management data. The project team completed empirical estimates of soil carbon change at 1-km resolution and developed a soil carbon base map that is adjusted based on a history of crop management. The project team also developed a method to include sequestration adoption risks in the Policy Analysis System (POLYSYS) economic model. In FY06, the project team will pursue activities leading to a full integration of remote sensing data, land-use scenarios, and soil management approaches into the POLYSYS economic model.

Decision Support Systems for Carbon Management across the U.S. Corn Belt using NASA Remote Sensing Data Products
The Carbon program initiated this project in FY05, and the project team mapped residue management and tillage practice across the study swath in Iowa, Illinois and Indiana and developed a database for the study area. The project also calibrated the EPIC-Century model (Erosion Productivity Impact Calculator). In FY06, the project team will continue these tasks and evaluate the decision tool for carbon management practices.

CARBON CYCLE PROJECTS

In 2005, the Carbon Management program initiated three projects that were selected under the 2004 NASA Carbon Cycle solicitation. These five-year projects are co-funded by the Applied Sciences Program and either the Earth Science Research Program or the carbon management element of the USDA Cooperative Research Education and Extension Service (CSREES).

Projections of Land-Use Change and the Carbon Cycle
Initiated in March 2005, the project team developed tools for data integration and manipulation. In FY06, the project team will implement a terrestrial carbon-cycle model, begin parameter estimation using a coupled model, and use software tools to enhance Integrated Assessment Models (IAM) representations of wind and solar energy.

CO_2 Fluxes between Agricultural Lands and the Atmosphere: Towards More Complete Accounting by Integrating Remote Sensing with Simulation Modeling
Initiated in June 2005, the project team completed a U.S. national carbon sequestration inventory using MODIS 1-km land surface products. This inventory will form the basis for an integrated analysis of past trends in coupled framework with the Century model. The project team also completed a national carbon assessment for soil carbon stock changes in agricultural lands using Century, and this assessment will be used as the basis to form the CASA-Century combined assessment during this project. In FY06, the

project team will conduct model testing for a combined CASA-Century framework and will establish a benchmark sampling network for carbon stocks.

North American Forest Disturbance and Regrowth Since 1972: Empirical Assessment with Field Measurements and Satellite Remotely Sensed Observations
Initiated in February 2005, the project team (working with the USDA Forest Service's Forest Inventory and Assessment (FIA) project) developed methods to produce Landsat-based "data cubes" for use in FIA. Contacts in each of the FIA regions work with the project team to compare the data cubes with FIA field measurements. In FY06, the project team will complete the first analysis of data cubes in each FIA region and evaluate the potential of FIA adopting this technology.

ADDITIONAL ACTIVITIES & ISSUES FOR FY06

In FY05, the Carbon Management program manager continued his role as one of two NASA representatives on the Carbon Cycle Interagency Working Group of the Climate Change Science Program.

In FY06, the Carbon Management program element will pursue activities that extend carbon management activities to aquatic and oceanic systems. The program will begin the evaluation of NASA observations relevant to carbon management that will be acquired from new Earth observing systems in the next three years, such as the Orbiting Carbon Observatory (OCO). In addition, the program will begin the first project focused on the evaluation of NASA capabilities for carbon sequestration managed by and within the private sector; the program expects an evaluation report by the end of 2006.

SOLICITATIONS

Decisions CAN
The Carbon Management program element received 9 Step-1 proposals in the Decisions CAN and encouraged 4 to submit full proposals. In Step-2, the Carbon Management program element received 7 full proposals.

Following the panel reviews and internal assessment for programmatic balance, the Applied Sciences Program selected the following Carbon Management proposals to be combined into a single three-year project:

> Decision Support for Loblolly Pine Carbon Management: From Research to Operations
> *PI: Randolph Wynne, Virginia Polytechnic and State University*
>
> Integration of Decision Support Tools for Managing Carbon Sequestration in the U.S. Forest Sector
> *PI: Chris Potter, NASA Ames Research Center*

ROSES 2005 – Section A.24
For the Applied Sciences portion of the ROSES 2005 NRA, the Carbon Management program element received 4 Step-1 proposals and encouraged 2 to submit full proposals. The Step-2 proposals were due in November 2005 with selections expected by April 2006.

PUBLICATIONS (SELECTED)

Ryan, M. with B. Law, "Interpreting, measuring and modeling soil respiration," *Biogeochemistry*, Vol. 73, No. 1, March 2005, pp. 3-27.

CONFERENCE/WORKSHOP PRESENTATIONS (SELECTED)

Doriaswamy, P., "Simulation of Erosion and Soil Carbon Sequestration over an Agricultural Landscape in Iowa" (Baltimore, Maryland; March 21-24, 2005 – USDA Symposium on Greenhouse Gases and Carbon Sequestration in Agriculture and Forestry).

Ogle, S. with C. Potter, "Past Impacts and Future Scenarios of Climate on Ecosystem Carbon Balance for the Western United States" (Sacramento, CA; September, 2005 - Second Annual Conference on Climate Change in the Western United States).

Townshend, J., "Large Volume Data Systems" (San Diego, CA; 2005 – ESRI Users Conference).

Townshend, J., "The GLCF and Biodiversity Conservation" (Washington, DC; August 29, 2005 – NASA Biodiversity and Ecological Forecasting Meeting). "Improving Automated Detection of Forest Cover Change for Large Areas using Landsat Data" (Biloxi, Mississippi; May 2005 – MultiTemp 2005).

West, T., "A Farm-Level Evaluation of Conditions under Which Farmers Will Supply Biomass Feedstocks for Energy Production" (July 24-27, 2005 – American Agricultural Economics Association Annual Meeting, Providence, RI).

CONTACT INFORMATION

Ed Sheffner, Program Element Manager
Telephone: 202-358-0239
E-mail: Edwin.J.Sheffner@nasa.gov